IS 9000-18-1 to 3 (1981): Basic Environmental Testing Procedures for Electronic and Electrical Items, Part 18: Solderability Test (Sections 1-3) [LITD 1: Environmental Testing Procedure]

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BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART XVIII SOLDERABILITY TEST

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Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART XVIII SOLDERABILITY TEST

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AMENDMENT NO. 1 SEPTEMBER 1984

TO

IS:9000(Part 18)-1981 BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART 18 SOLDERABILITY TEST

Addenda

(*Page 13, clause 10.4.5*) - Add the following new para at the end of this clause:

'An interval of the order of 5 to 10 s shall be observed between applications to different terminations of a component to avoid excessive heating.'

(*Page 23, clause 8.3, first para*) - Add the following new para after this clause:

'An interval of the order of 5 to 10 s shall be observed between applications to different terminations of a component to avoid excessive heating.

(LTDC 2)

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Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART XVIII SOLDERABILITY TEST

0. FOREWORD

0.1 This Indian Standard (Part XVIII) was adopted by the Indian Standards Institution on 6 March 1981, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The differences in environmental testing procedures for component type items and equipment type items are fast disappearing in the context of technological developments. It is, therefore, found necessary to have uniform testing procedures wherever possible. This series of standards on environmental testing procedures (IS : 9000) has been prepared with this objective. This is also in line with the principle adopted by IEC/TC 50 Environmental testing in developing unified series of standards on environmental testing procedures by International Electrotechnical Commission.

0.2.1 It is proposed to withdraw the existing Indian Standards, namely, IS : 589-1961* and IS : 2106† series dealing with environmental tests for electronic components and equipment respectively, as soon as the tests mentioned therein are covered in the new series (IS : 9000).

0.3 This standard covers the following tests in three sections:

Sec 1 Solderability of wire and tag terminations,

Sec 2 Resistance of items to soldering heat, and

Sec 3 Solderability of printed boards and metal-clad laminates.

0.4 This standard shall be read in conjunction with IS : 9001 (Part IX)-1981‡.

*Basic climatic and mechanical durability tests for components for electronic and eectrical equipment (*revised*).

†Environmental test, for electronic and electrical equipment.

‡Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

0.5 While preparing this standard, assistance has been derived from the following :

IEC Pub 68-2-20 (1979) Basic environmental testing procedures, Part 2 : Test T : Soldering. International Electrotechnical Commission.

IEC Pub 68-2-44 (1979) Basic enviromental testing procedures, Part 2 : Tests, Tests-Guidance on Test T : Soldering. International Electrotechnical Commission.

0.6 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

*Rules for rounding off numerical values (*revised*).

Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART XVIII SOLDERABILITY TEST

Section 1 Solderability of Wire and Tag Terminations

1. SCOPE

1.1 This standard (Part XVIII/Sec 1) gives the procedure for solderability test on wire and tag terminations as a part of the basic environmental testing procedures.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions and explanation of terms given in IS : 9000 (Part I)-1977* and IS : 9001 (Part IX)-1981† shall apply.

3. OBJECT

3.1 The object of this test is to determine the solderability of the areas on wire and tag terminations that are required to be wetted by solder, and, if required, to determine any de-wetting.

4. GENERAL DESCRIPTION OF THE TEST

4.1 This test provides three different test methods, namely:

Method 1 : Solder globule at 235°C (*see* **8**)

Method 2 : Solder bath at 235°C (*see* **9**)

Method 3 : Soldering iron at 350°C (*see* **10**)

With Method 1, the solder globule method, a test item of round wire termination bisects a globule of molten solder of a given weight. It is easy to apply and the soldering time is a precise inspection criterion.

*Basic environmental testing procedures for electronic and electrical items: Part I General.

†Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

Method 2 with suitable changes in times and temperatures is used to determine de-wetting behaviour. The solder bath method is the one which simulates most closely the soldering procedures that are generally used in practice; however, it is not practicable to express the results as a number.

Method 3, the soldering iron method, may be used in cases where the other two methods are impracticable.

The test method to be used shall be indicated in the relevant specification.

If required by the relevant specification, the test conditioning may be preceded by accelerated ageing. The relevant specification shall indicate one of the following ageing procedures:

Ageing 1a : 1 hour steam ageing

Ageing 1b : 4 hours steam ageing

Ageing 2 : 10 days damp heat, steady state condition

Ageing 3 : 16 hours at 155°C dry heat

5. PREPARATION OF TEST ITEM

5.1 The surface to be tested shall be in the 'as received' condition and shall not be subsequently touched by the fingers or otherwise contaminated.

5.2 The item shall not be cleaned prior to the application of a solderability test. If required by the relevant specification, the item may be degreased by immersion in a neutral organic solvent at room temperature.

6. INITIAL MEASUREMENTS

6.1 The items shall be visually examined and, if required by the relevant specification, electrically and mechanically checked.

7. ACCELERATED AGEING

7.1 If accelerated ageing is required by the relevant specification, one of the following methods shall be adopted.

NOTE—Terminations may be detached if the ageing temperature is higher than the component's maximum operating or storage temperature, or if the component is likely to degrade considerably at 100°C in steam and thus affect the solderability in a manner which would not normally occur in natural ageing.

7.1.1 *Ageing 1* — The relevant specification shall indicate whether ageing 1a (1 hour in steam) or ageing 1b (4 hours in steam) is to be used. For these procedures the test item is suspended, preferably with the termination vertical, with the area to be tested positioned 25 to 30 mm above the surface

of boiling distilled water which is contained in a borosilicate glass or stainless steel vessel of suitable size (for example, a 2-1. beaker). The termination shall be not less than 10 mm from the walls of the vessel.

The vessel shall be provided with a cover of like material consisting of one or more plates which are capable of covering approximately seven-eighths of the opening. A suitable method of suspending the items shall be devised; perforations or slots in the cover are permitted for this purpose. The item holder shall be non-metallic.

The level of water shall be maintained by the addition of hot distilled water, added gradually in small quantities, so that the water will continue to boil vigorously; alternatively, a reflux condenser may be provided, if desired (*see* Fig. 1).

Duration : 1 or 4 hours.

7.1.2 *Ageing 2* — Test items are subjected to 10 days damp heat, steady state, (40 $\pm$ 2°C, 93 $+\frac{2}{3}$ percent RH) according to IS : 9000 (Part IV)-1979*.

7.1.3 *Ageing 3* — Test items are subjected to 16 hours dry heat at 155°C according to Sec 2 of IS : 9000 (Part III)-1977†.

7.2 At the end of the conditioning, the item shall be subjected to standard atmospheric conditions of testing for not less than 2 hours and not more than 24 hours.

8. METHOD 1 SOLDER GLOBULE AT 235°C

8.1 This method provides a procedure to measure the soldering time of round wire terminations.

8.2 Method — The apparatus described in Appendix A is designed so that a globule of molten solder is bisected by the wire. The time elapsing between the moment that the wire bisects the solder and that when the solder flows around and covers the wire, is indicative of the solderability of the wire.

8.3 Conditions of Test

8.3.1 *Solder* — Solder pellets conforming to Sn 60 of IS : 193-1977‡ as specified in Appendix A of IS : 9001 (Part IX)-1981§ are related to the

*Basic environmental testing procedures for electronic and electrical items: Part IV damp heat (steady state).

†Basic environmental testing procedures for electronic and electrical items: Part III Dry heat test.

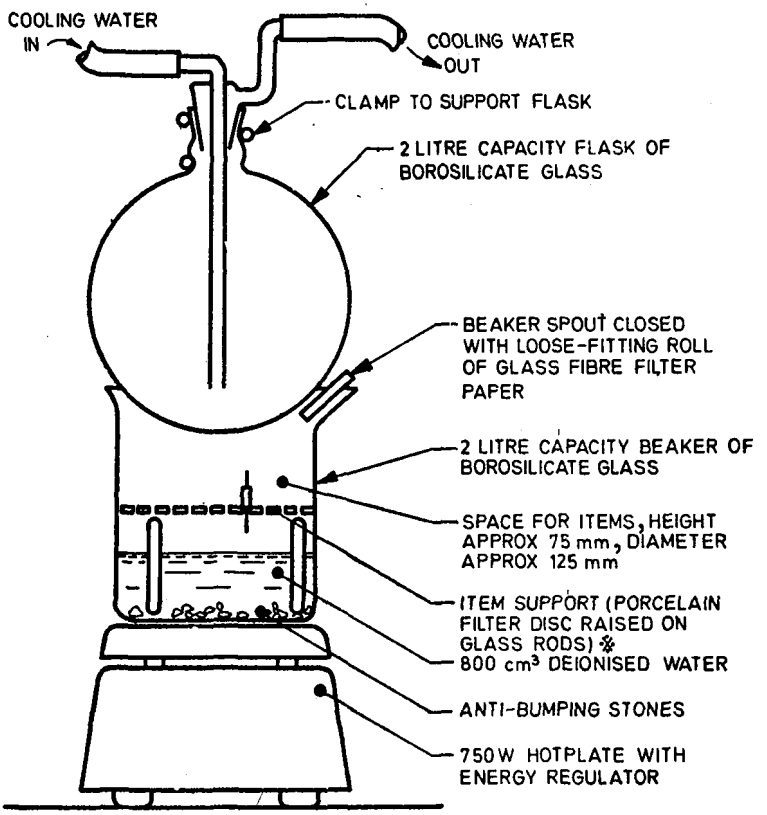
‡Specification for soft solder (*third revision*).

§Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

wire diameter as follows:

Nominal Wire Diameter (mm)	*Nominal Pellet Weight* (mg)
1·2 - 0·75	200
0·74 - 0·55	125
0·54 - 0·25	75
0·24 and less	50

NOTE — For admissible deviations from nominal weight, *see* IS : 9001 (Part IX) - 1981* 'Guidance for environmental testing: Part IX Solderability and resistance to soldering heat'.



*Item should not be placed under the lowest portion of the cooling flask because of dripping water.

FIG. 1 EXAMPLE OF APPARATUS FOR ACCELERATED STEAM AGEING PROCESS

8.3.2 *Temperature of the Iron Pin* — The apparatus shall be so adjusted that the temperature measured as indicated in Appendix A (*see* Figs. 4 and 5 under Appendix A) is maintained at 235 ± 2°C.

8.3.3 *Flux*

8.3.3.1 The flux to be used shall consist of 25 percent by weight of colophony (*see* IS : 553-1969*) in 75 percent by weight of 2-propanol (*iso*propanol) (*see* IS : 2631-1976†) or of ethyl alcohol (*see* IS : 324-1959‡), as specified in Appendix B of IS : 9001 (Part IX)-1981§.

CAUTION — In case ethyl alcohol is used, it shall be tested to comply with the requirements of **B-3** of IS : 9001 (Part IX)-1981§ before usage.

8.3.3.2 When a non-activated flux is inappropriate, the above flux with the addition of diethylammonium chloride (analytical reagent grade), up to an amount of 0·5 percent chloride (expressed as free chlorine based on the colophony content), may be used as required by the relevant specification.

8.4 Procedure

8.4.1 Wires for test should be substantially straight and, if necessary or convenient, they may be detached from an item prior to testing.

8.4.2 The wires shall not be cleaned prior to the application of a solderability test. If required by the relevant specification, the wires shall be degreased by immersion in a neutral organic solvent agent at room temperature.

8.4.3 The residue of solder from the previous test shall be removed from the soldering block by wiping, before a new solder pellet, selected in accordance with **8.3.1**, is placed in position on the soldering block.

8.4.4 The flux is applied to the wire either by dipping it in the flux or by brushing when it is in position in the test apparatus. A small amouut of flux is also applied to the molten globule of solder to ensure that it is clean and free from oxides, and that it completely wets the iron pin.

8.4.5 The wire for test is then placed into the globule so that it touches the surface of the iron pin.

8.5 Requirements — The time elapsing between the moment the wire bisects the solder and touches the iron pin, and the moment the solder flows around

*Specification for rosin (gum rosin) (*first revision*).

†Specification for *iso*propyl alcohol (*first revision*).

‡Specification for ordinary denatured spirit (*revised*).

§Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

and covers the wire, is the soldering time. Its maximum value shall be prescribed in the relevant specification.

9. METHOD 2 SOLDER BATH AT 235°C

9.1 This method provides a procedure for assessing the solderability of wires, tags and terminations of irregular form.

9.2 Description of Solder Bath — The solder bath shall be not less than 40 mm in depth and not less than 300 ml in volume. The bath shall contain solder conforming to Grade Sn 60 of IS : 193-1977* [for details, *see* Appendix A of IS : 9001 (Part IX)-1981†]; and the temperature of the solder in the bath prior to the test shall be 235 ± 5°C.

NOTE — To maintain a uniform temperature, it may be desirable to stir or agitate the molten solder in the bath.

9.3 Flux

9.3.1 The flux to be used shall consist of 25 percent by weight of colophony (*see* IS : 553-1969‡) in 75 percent by weight of 2-propanol (*iso*propanol) (*see* IS : 2631-1976§) or of ethyl alcohol (*see* IS : 324-1959‖), as specified in Appendix B of IS : 9001 (Part IX)-1981†.

CAUTION — In case ethyl alcohol is used, it shall be tested to comply with the requirements of **B-3** of IS : 9001 (Part IX)-1981† before usage.

9.3.2 When non-activated flux is inappropriate, the above flux with the addition of diethylammonium chloride (analytical reagent grade), up to an amount of 0·5 percent chloride (expressed as free chlorine based on the colophony content), may be used as required by the relevant specification.

9.4 Procedure

9.4.1 The surface of the molten solder shall be wiped clean and bright with a piece of suitable material immediately before each test.

9.4.2 The termination to be tested shall be immersed first in the flux described in **9.3** at laboratory temperature, and excess flux shall be eliminated either by draining off for a suitable time, or by using any other procedure likely to produce a similar result. In case of dispute, drainage shall be carried out for 1 min ± 5 s.

*Specification for soft solder (*third revision*).

†Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

‡Specification for rosin (gum rosin) (*first revision*).

§Specification for *iso*propyl alcohol (*first revision*).

‖Specification for ordinary denatured spirit (*revised*).

9.4.3 The termination is then immersed immediately in the solder bath in the direction of its longitudinal axis. The point of immersion of the termination shall be at a distance not less than 10 mm from the walls of the bath.

9.4.4 The speed of immersion shall be 25 ± 2·5 mm/s and the termination shall remain immersed for 2·0 ± 0·5 seconds with the body of the item at the distance above the solder prescribed in the relevant specification. The item shall then be withdrawn at 25 ± 2·5 mm/s. For items having a high thermal capacity, the relevant specification may prescribe an immersion time of 5·0 ± 0·5 seconds.

NOTE — To ensure immersion and withdrawal of terminations at the rate specified, it may be necessary to provide suitable mechanical lifting devices for the solder bath.

9.4.5 Unless otherwise specified, a screen of thermally insulating material of 1·5 ± 0·5 mm thickness with clearance holes appropriate to the size of the termination may be placed between the body of the item and the molten solder to avoid heating of items by direct radiation from the bath.

Any flux residue shall be removed with 2-propanol (*iso*propanol) or ethyl alcohol.

9.4 Requirements — Inspection shall be carried out under adequate light with normal eyesight or with the assistance of a magnifier capable of giving a magnification of 4 to 10 X.

The dipped surface shall be covered with a smooth and bright solder coating with no more than small amounts of scattered imperfections such as pin-holes or un-wetted or de-wetted areas. These imperfections shall not be concentrated in one area. A minimum of 95 percent of solderable surface of the terminations shall be covered by a continuous coating of solder.

10. METHOD 3 SOLDERING IRON AT 350°C

10.1 This method provides a procedure for assessing the solderability of terminations in cases where the solder bath or globule methods are impracticable.

10.2 Description of Soldering Irons

Size A

Bit temperature : 350 ± 10°C (at start of test)

Bit diameter : 8 mm

Exposed length : 32 mm reduced to a wedge shape over a length of approximately 10 mm.

Size B

Bit temperature : 350 ± 10°C (at start of test)

Bit diameter : 3 mm

Exposed length : 12 mm reduced to a wedge shape over a length of approximately 5 mm.

The bit shall be made of copper, preferably plated with iron or of erosion resistant copper alloy, in accordance with normal practice, and tinned on the test surface.

10.3 Solder and Flux — A cored solder wire conforming to Grade 60 of IS : 1921-1975* shall be used comprising solder as specified in Appendix A of IS : 9001 (Part IX)-1981† with a core or cores containing 2·5 to 3·5 percent colophony (*see* IS : 553-1969‡) as specified in Appendix B of IS : 9001 (Part IX)-1981†. A visual check is to be made during the test for the presence of flux.

10.4 Procedure

10.4.1 According to the type of item, a soldering iron of either Size A or Size B shall be used as prescribed in the relevant specification.

10.4.2 The nominal diameter of the solder wire to be used with soldering iron of Size A is 1·2 mm and with soldering iron of Size B is 0·8 mm.

10.4.3 The termination shall be positioned so that the iron can be applied to the test surface in an appropriate position. A typical case is shown in Fig. 2.

Should mechanical support for the terminations be required while performing this test, such support shall be of thermally insulating material.

When testing heat-sensitive components, the relevant specification shall specify the distance of the test area from the component body, or the use of a specific heat shunt.

The relevant specification may specify different conditions where the geometry of the terminations renders the above procedure impracticable.

10.4.4 Surplus solder which has remained on the test surface of the iron from a previous test shall be wiped off.

NOTE — A lint free cloth may be used for wiping the surface of the soldering iron.

*Specification for rosin-cored solder wire (*first revision*).

†Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

‡Specification for rosin (gum rosin) (*first revision*).

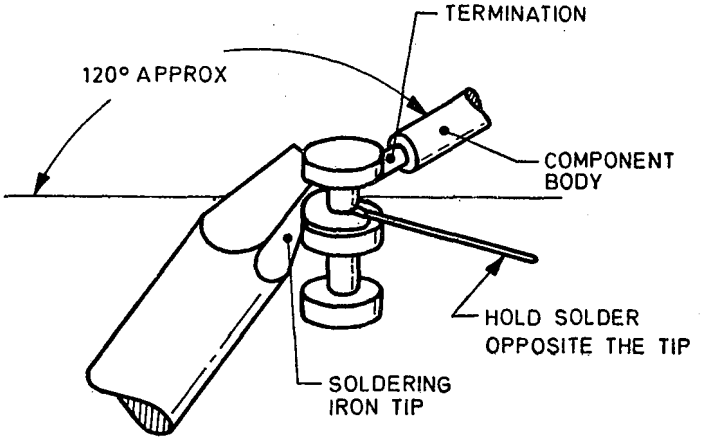


FIG. 2 SOLDERING IRON METHOD

10.4.5 The soldering iron and the solder shall, unless otherwise specified, be applied to the termination for 2 to 3 seconds at a position:

a) as to leave a clearance of 6 mm from the point where the termination emerges from the body or cap of the component;

b) as to leave a clearance of 3 mm beyond the space intended for connection of wires referred to the free end or one half of the tag length whichever is less; or

c) as specified in the relevant specification.

During this period of time, the soldering iron shall be kept stationary.

10.4.6 Any flux residue shall be removed with 2-propanol (*iso*propanol) or with ethyl alcohol.

10.4.7 *Requirements* — Inspection shall be carried out under adequate light with normal eyesight or with the assistance of a magnifier capable of giving a magnification of 4 to 10 X.

The dipped surface shall be covered with a smooth and bright solder coating with no more than small amounts of scattered imperfections such as pin-holes or un-wetted or de-wetted areas. These imperfections shall not be concentrated in one area. A minimum of 95 percent of solderable surface of the terminations shall be covered by a continuous coating of solder.

11. DE-WETTING

NOTE 1 — The relevant specification shall prescribe whether this test is required.

NOTE 2 — Items subjected to de-wetting test shall not be used for any subsequent testing.

11.1 Description of Solder Bath — The solder bath shall be not less than 40 mm in depth and not less than 300 ml in volume. The bath shall contain solder conforming to Grade Sn60 of IS : 193-1977* [for details, *see* Appendix A of IS : 9001 (Part IX)-1981†]; and the temperature of the solder in the bath prior to the test shall be 260 ± 5°C.

NOTE — To maintain a uniform temperature, it may be desirable to stir or agitate the molten solder in the bath.

11.2 Procedure — The surface of the molten solder shall be wiped clean and bright with a piece of suitable material immediately before each test.

The termination to be tested shall be immersed first in the flux described in **9.3** at laboratory temperature and excess flux shall be eliminated either by draining off for a suitable time, or by using any other procedure likely to produce a similar result. In case of dispute, drainage shall be carried out for 1 min ± 5 s.

The termination is then immersed immediately in the solder bath in the direction of its longitudinal axis. The point of immersion of the termination shall be at a distance not less than 10 mm from the walls of the bath.

The speed of immersion shall be 5 ± 2 mm/s and the termination shall remain immersed for 5·0 ± 0·5 s with the body of the component at the distance above the solder prescribed in the relevant specification. The item is then withdrawn at the same speed.

On withdrawal from the solder bath, the termination shall remain with the test surfaces vertical until the solder solidifies.

Any flux residue shall be removed with 2-propanol (*iso*propanol) or ethyl alcohol.

11.3 Requirements — Inspection shall be carried out under adequate light with normal eyesight or with the assistance of a magnifier capable of giving a magnification of 4 to 10 X.

The dipped surface shall be covered with a smooth and bright solder coating with no more than small amounts of scattered imperfections such as pin-holes or unwetted or de-wetted areas. These imperfections shall not be concentrated in one area.

*Specification for soft solder (*third revision*).

†Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

11.4 The procedure described in **11.2** shall then be repeated. This will result in a total immersion of 10 seconds.

12. FINAL MEASUREMENTS

12.1 The items shall be visually examined and, if required by the relevant specification, electrically and mechanically checked.

13. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

13.1 When this test is included in the relevant specification, the following details shall be given as far as they are applicable:

	Clause Reference
a) Whether degreasing is required	5.2, 8.4
b) Initial measurements	6
c) Ageing method (if required)	7
d) Test method	8, 9, 10
e) Whether activated flux shall be used	8.3.3, 9.3
f) Immersion depth and time (if not 2 seconds)	9.4, 11.2
g) Whether a thermal screen is to be used	9.4
h) Size of soldering iron (A or B)	10.4
j) Distance of test area from component body or use of a heat sink	10.4
k) Different test conditions, if required by geometry of termination	10.4
m) Position of the soldering iron	10.4
n) Application time of soldering iron, if not 2 to 3 seconds	10.4
p) Soldering time	8.5
q) Whether the de-wetting test is required	11
r) Immersion depth	11.2
s) Final measurements	12

APPENDIX A

(*Clauses* 8.2 *and* 8.3.2)

SPECIFICATION FOR SOLDER GLOBULE APPARATUS

A-1. The body (Fig. 3, Detail 1), shall be made from non-heat-treatable aluminium bar having a minimum tensile strength of 170 N/mm^2, and having the following chemical composition:

Magnesium	1·7 - 2·8 percent
Copper	0·1 percent, *Max*
Silicon	0·6 percent, *Max*
Iron	0·5 percent, *Max*
Manganese	0·5 percent, *Max*
Chromium	0·25 percent, *Max*
Zinc	0·2 percent, *Max*
Titanium or other grain-refining elements	0·15 percent, *Max*
Aluminium	the remainder

A-2. The pin (Fig. 3, Detail 2) shall be made from pure iron having the following chemical composition:

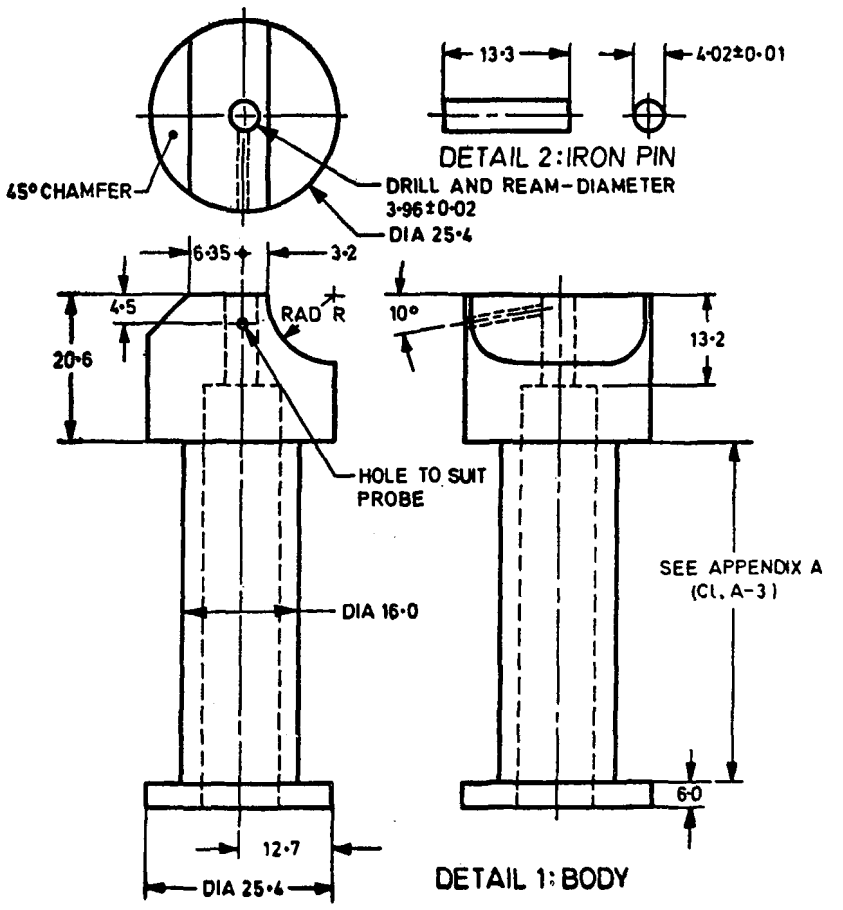
Carbon	0·05 percent, *Max*
Oxygen	0·02 percent, *Max*
Nitrogen	0·02 percent, *Max*
Other impurities	15×10^{-6}
Iron	the remainder

A-3. The body shall be heated by an electrical heater wound on the 16 mm diameter. The length of the section at this diameter may be varied to suit the heater available, provided that this length does not exceed 60 mm.

A-4. The body may be bored out as shown in Fig. 4 to accommodate a thermostat, or the heater may be controlled by any other means which will ensure a temperature of 235 $\pm$ 2°C when measured as specified in **A-5.**

A-5. The temperature shall be measured by inserting any suitable probe, (such as a thermocouple, thermistor or platinum resistance wire) in the hole provided (*see* Fig. 3).

A-6. Any convenient device may be used to place the item into the solder globule, but it is recommended that the item clamps should be thermally insulated (*see* Fig. 5).



All dimensions in millimetres.

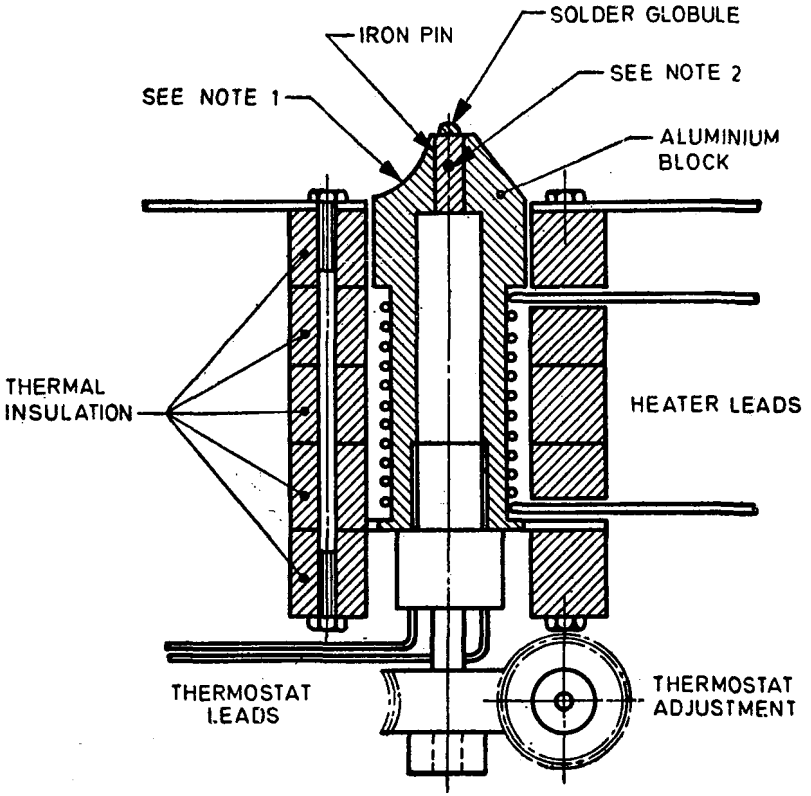
Tolerance ± 0·1, unless otherwise stated.

Assembly

1. Heat body to 500°C approximately and drive iron pin into reamed hole.

2. After insertion of the iron pin, the end face and face of radius *R* should be finished smooth.

FIG. 3 ALUMINIUM BODY



NOTE 1 — Cut away for body of component.

NOTE 2 — Position of centre of hole in block in relation to the periphery of the iron pin for the insertion of the thermocouple to the cylindrical surface of the pin.

FIG. 4 APPARATUS FOR GLOBULE SOLDERABILITY TEST

A-7. The top surface of the iron pin shall be tinned. After completion of the test, the heating block should be allowed to cool with a solder globule in position to prevent oxidation of the iron pin and consequent de-wetting.

A-8. Other test machines which may not be made entirely in accordance with this specification may be used provided that they meet the following requirements.

A-8.1 The temperature of the iron pin shall be maintained at 235 $\pm$ 2°C.

A-8.2 The temperature of the solder in the following test is measured by means of a thermocouple with a volume not greater than 0·2 mm^3 (for example, of NiCr—Ni or of chromel-alumel) and placed in the globule.

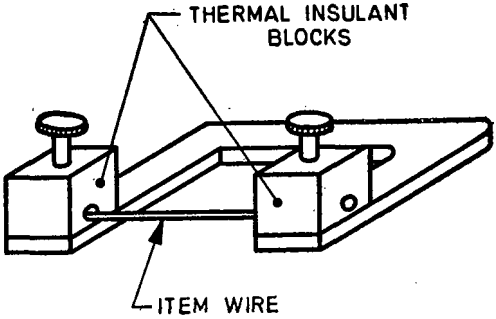


FIG. 5 HOLDER FOR TERMINATION

A freshly tinned copper wire of nominal diameter 0·8 mm and 50 ± 2 mm long is fixed with clamps which are formed such that thermal conduction for the item is minimal and then inserted into the solder globule.

The following conditions shall be met:

a) In at least five out of seven repeats of the test, the temperature after 3 seconds is not below 222°C; and

b) The temperature does not fall below 210°C at any time during the test.

Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART XVIII SOLDERABILITY TEST

Section 2 Resistance of Items to Soldering Heat

1. SCOPE

1.1 This standard (Part XVIII/Sec 2) deals with the procedure for resistance of electronic and electrical items to soldering heat, as a part of environmental testing procedures.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions and explanation of terms given in IS : 9000 (Part I)-1977* and IS : 9001 (Part IX)-1981† shall apply.

3. OBJECT

3.1 The object of this test is to determine the ability of electronic and electrical items to withstand the heating stresses produced by soldering.

4. GENERAL DESCRIPTION OF THE TEST

4.1 The test provides three different methods, that is:

Method 1A: Solder bath at 260°C (*see* **6**),
Method 1B: Solder bath at 350°C (*see* **7**), and
Method 2 : Soldering iron at 350°C (*see* **8**).

4.1.1 Methods 1A and 1B are identical with Method 2 of Sec 1, but with different immersion times and temperatures.

4.1.2 Method 2 is identical with Method 3 of Sec 1, but with the soldering iron applied to the test surface for 10 seconds.

*Basic environmental testing procedures for electronic and electrical items: Part I General.

†Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

5. INITIAL MEASUREMENTS

5.1 The items shall be visually examined and electrically and mechanically checked as required by the relevant specification.

6. METHOD 1A SOLDER BATH AT 260°C

6.1 Solder Bath — The solder bath shall be not less than 40 mm in depth and not less than 300 ml in volume. The bath shall contain solder conforming to grade Sn 60 of IS : 193-1977* [for details, *see* Appendix A of IS : 9001 (Part IX)-1981†], and the temperature of the solder in the bath prior to the test shall be 260 ± 5°C.

NOTE — To maintain a uniform temperature, it may be desirable to stir or agitate the molten solder in the bath.

6.2 Flux

6.2.1 The flux to be used shall consist of 25 percent by weight of colophony (*see* IS : 553-1969‡) in 75 percent by weight of 2-propanol (*iso*propanol) (*see* IS : 2631-1976§) or ethyl alcohol (*see* IS : 324-1959‖), as specified in Appendix B of IS : 9001 (Part IX)-1981†.

CAUTION — In case ethyl alcohol is used, it shall be tested to comply with the requirements of **B-3** of IS : 9001 (Part IX)-1981† before usage.

6.2.2 When the test forms part of a test sequence and is applied prior to a humidity test, a non-activated flux comprising 25 percent by weight of colophony in 75 percent by weight 2-propanol (*iso*propanol) or ethyl alcohol shall be used. In this case, the test shall be made on items which have a surface which has satisfactorily passed the solderability test according to Method 2 of Sec 1, within the previous 72 hours period.

6.3 Procedure

6.3.1 The surface of the molten solder shall be wiped clean and bright by wiping with a piece of suitable material immediately before each test.

6.3.2 The termination to be tested shall be immersed first in the flux described in **6.2** at laboratory temperature, and then in the solder bath, in the direction of its longitudinal axis. The point of immersion of the termination shall be at a distance not less than 10 mm from the walls of the bath.

*Specification for soft solder (*third revision*).

†Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

‡Specification for rosin (gum rosin) (*first revision*).

§Specification for *iso*propyl alcohol (*first revision*).

‖Specification for ordinary denatured spirit (*revised*).

6.3.3 Immersion of the termination to within 2·0 to 2·5 mm from the point of emergence of the termination of the component, unless otherwise specified in the relevant specification, shall be completed in a time not exceeding 1 second. The termination shall remain immersed to the specified depth for one of the following durations, as prescribed in the relevant specification:

a) 5 ± 1 seconds

b) 10 ± 1 seconds

NOTE — The shorter immersion time of 5 seconds is mainly intended for heat-sensitive components to be mounted on printed circuits. A warning should be given to the user that such components should be soldered to the printed circuit in less then 4 seconds.

6.3.4 Unless otherwise specified in the relevant specification, a screen of thermally insulating material of 1·5 ± 0·5 mm thickness, with clearance holes appropriate to the size of the termination, shall be placed between the body of the component and the molten solder to avoid heating of items by direct radiation from the bath.

6.3.5 When the relevant specification prescribes the use of a heat shunt during this test, it shall give full details of the size and type of heat shunt to be used, which should be related to the method used for production soldering.

7. METHOD 1B SOLDER BATH AT 350°C

7.1 Solder Bath — The solder bath shall be the same as prescribed in **6.1** but at a temperature of 350 ± 10°C.

7.2 Procedure — The procedure shall be the same as prescribed in **6.3** but with an immersion time of 3·5 ± 0·5 seconds. The whole process of immersion, dwell in the bath and withdrawal shall be completed in not more than 5 seconds nor less than 3·5 seconds.

8. METHOD 2 SOLDERING IRON AT 350°C

8.1 Description of Soldering Iron — As prescribed in **10.2** of Sec 1.

The relevant specification shall state whether soldering iron *A* or *B* is to be used.

8.2 Solder and Flux — As prescribed in **10.3** of Sec 1.

8.3 Procedure — As prescribed in **10.4** Method 3 of Sec 1, but with the soldering iron applied to the test surface of the termination for 10 ± 1 seconds.

For heat sensitive components, the relevant specification shall specify the distance of the test area from the component body, or the use of a specific heat shunt.

9. RECOVERY

9.1 The item shall remain under standard atmospheric conditions for testing as prescribed in IS : 9000 (Part I)-1977*, for a period of 30 minutes, or until thermally stabilized.

NOTE — It may occur with certain items, such as some semi-conductors and capacitors, that the electrical properties are stabilized only some hours after heat stability is reached.

10. FINAL MEASUREMENTS

10.1 The items shall be visually inspected and electrically and mechanically checked as required by the relevant specification.

11. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

11.1 When this test is included in the relevant specification, the following details shall be given as far as they are applicable:

	Clause Reference
a) Initial measurements	5
b) Test method to be applied	6, 7 or 8
c) Immersion depth, if different from 2·0 to 2·5 mm from the component	6.3.3
d) Immersion time	6.3.3
e) Whether a thermal screen is not to be used and details of a heat shunt, if required	6.3.4, 6.3.5
f) Size (A or B) of soldering iron	8.1
g) Distance of the test area from the component body or use of a specific heat shunt	8.3
h) Final measurements	10

*Basic environmental testing procedures for electronic and electrical items: Part I General.

Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART XVIII SOLDERABILITY TEST

Section 3 Solderability of Printed Boards and Metal-Clad Laminates

1. SCOPE

1.1 This standard (Part XVIII/Sec 3) gives the procedure for solderability test of printed boards and metal-clad laminates as a part of basic environmental testing procedures.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions and explanation of terms given in *IS : 9000 (Part I)-1977** and *IS : 9001 (Part IX)-1981†* shall apply.

3. OBJECT

3.1 The object of this test is to determine the solderability, and to incorporate a test procedure for de-wetting, of areas required to be solderable on:

a) single or double-sided metal clad laminates;

b) single or double-sided printed wiring boards, with or without plated through holes; and

c) multilayer printed wiring boards.

NOTE — Double-sided boards shall have each face tested individually.

4. GENERAL DESCRIPTION OF THE TEST

4.1 Mass soldering of printed wiring board assemblies is a manufacturing operation used widely throughout industry. One method uses flow, or wave

*Basic environmental testing procedures for electronic and electrical items: Part I General.

†Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

soldering where the printed board is fixed to a moving carrier so that it can be passed over a standing wave to molten solder. The test procedure described below is to provide a reproducible assessment of the ease, or difficulty, of obtaining a good soldered surface on any particular metal clad board.

4.2 A rectangular pattern cut from metal clad laminate or from single or double-sided printed wiring board is fluxed and then conveyed fluxing at constant speed in a circular path about a horizontal axis, so that the test face makes contact with the molten solder. The pattern/solder contact time is controlled with a timing device. The wetting and the dewetting properties of the pattern are evaluated in accordance with the relevant specification.

5. TEST PATTERN

5.1 The test pattern shall be a rectangle of width 30 ± 1 mm, and of length suitable to comply with **6.3.1**(a), cut from:

a) single and double sided metal clad laminate: an unetched pattern shall be used;

b) single or double-sided printed wiring boards, with or without plated-through holes: an appropriate part of the typical test patterns given in the relevant specification shall be used; and

c) multilayer printed wiring boards: an appropriate part of the typical test patterns given in the relevant specification shall be used.

5.2 Test patterns at **5.1**(b) and (c) shall be manufactured at the same time and under the same conditions as the manufacture of the production batch of printed wiring boards.

NOTE — To ensure this, test patterns may be incorporated as extensions to the production pattern.

When the test patterns at **5.1**(b) and (c) are not cut from any of the test patterns given in the relevant specification, the conductor widths, insulation gaps, lands, holes, and thermal shunt effects shall be considered. The test pattern shall exclude conductor configurations, etc, likely to affect the assessment of solderability. It is not the intention to prove whether a specific design of board will solder. The test pattern should be selected to test the solderability of the copper or deposited metals.

6. TEST APPARATUS

6.1 Solder Bath — A suitable solder bath of depth not less than 40 mm shall be used. If round, the bath shall be not less than 120 mm in diameter, and if rectangular not smaller than 100 × 75 mm.

6.2 Conveyance of Test Pattern

6.2.1 A mechanical device shall convey the test pattern at constant speed, without any stop while in contact with the solder, in circular path about a horizontal axis, so that the test face makes contact with the molten solder. The radius of rotation shall pass through the centre of the face of the test pattern at right angles, and the distance between the test face and the axis of rotation shall be 100 ± 5 mm (*see* Fig. 1 showing suggested test pattern holder and timing needle arrangement).

6.2.2 The range of speed of rotation shall be such that test pattern/solder contact times (as defined in **6.4**) can be obtained within the range of 1 to 8 seconds.

6.2.3 The depth of immersion of the test face in the molten solder shall not exceed the board thickness when the board is in the horizontal position. It is important to ensure that solder does not flow over the upper face of the test pattern, and it is therefore permissible to use a test pattern holder incorporating a frame to prevent this happening (*see* **6.3**).

6.3 Test Pattern Holder

6.3.1 The test pattern holder shall be of any design provided that it holds the test pattern as defined in **6.2** (*see also* Fig. 1) and satisfies the following requirements:

a) The exposed length of test pattern test face in the direction of travel shall be 25 ± 1 mm,

b) Those parts of the holder (including the retaining spring if fitted) which come into contact with the test pattern or the solder should have low thermal capacity and low thermal conductivity, and

c) The holder does not impede in any way the wetting of the exposed surface.

6.4 Timing Device

6.4.1 The time of contact between the test face of the test pattern and the molten solder shall be determined by a timer activated by the electrical contact of a needle with the molten solder. The tip of the needle shall be located adjacent to the test pattern, and it shall be on the same axis and radius of rotation as the centre of the test face of the pattern. The needle should be insulated from the test pattern holder which carries it (*see* Fig. 1), and shall be kept clean between tests.

6.4.2 As the dimensions of the needle can affect the recorded time, each equipment shall be calibrated for the arrangement used.

6.5 Solder Cleaning — A strip of suitable material, for example, polyetrafluorethylene (PTFE), 50 mm wide, shall be mounted on the test apparatus

in such a way that it precedes the test pattern by a maximum of 10 mm during the test cycle in order to remove oxide or flux-residue from the solder surface before the test pattern is introduced.

6.6 Solder — The bath shall contain solder as specified in Appendix A of IS : 9001 (Part IX)-1981* and the temperature of the solder in the bath prior to the test shall be in accordance with the relevant specification.

NOTE — To maintain a uniform temperature, it may be desirable to stir or agitate the molten solder in the bath.

6.7 Flux — The relevant specification shall prescribe the use of one of the three fluxes, the compositions of which are as follows:

6.7.1 Twenty five percent by weight of colophony (*see* IS : 553-1969†) in 75 percent by weight of 2-propanol (*iso*propanol) (*see* IS : 2631-1976‡) or of ethyl alcohol (*see* IS : 324-1959§) as specified in Appendix B of IS : 9001 (Part IX)-1981* before usage.

CAUTION — In case ethyl alcohol is used, it shall be tested to comply with the requirements of B-3 of IS : 9001 (Part IX)-1981* before usage.

6.7.2 Flux as in **6.7.1** with the addition of diethylammonium chloride (analytical reagent grade) up to an amount of 0·2 percent chloride (expressed as free chlorine based on the colophony content).

6.7.3 Flux as in **6.7.2** but with an amount of 0·5 percent chloride.

6.8 Accelerated Ageing — If accelerated ageing is required to be carried out before testing for solderability, the procedure to be adopted shall be prescribed in the relevant specification.

7. TEST PROCEDURE

7.1 General

7.1.1 The test pattern shall not be cleaned prior to the application of a solderability test. If required by the relevant specification, the test pattern may be degreased by immersion in a neutral organic solvent at room temperature.

7.1.2 The depth of immersion and operating speed shall be adjusted to provide the conditions stated in **6.2** and **7.2** respectively.

*Guidance for environmental testing: Part IX Solderability and resistance to soldering heat.

†Specification for rosin (gum rosin) (*first revision*).

‡Specification for *iso*propyl alcohol (*first revision*).

§Specification for denatured spirit (*revised*).

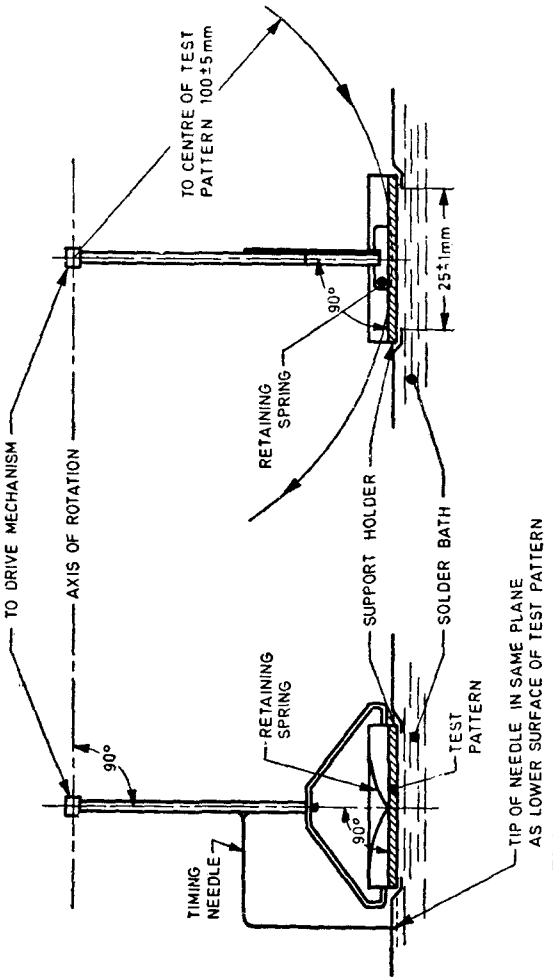


FIG. 1 TEST PATTERN HOLDER AND TIMING NEEDLE ARRANGEMENT

7.1.3 The test patterns prepared in accordance with **5** and **7.1** shall be fluxed by dipping in one of the fluxes prescribed in **6.7**.

The test pattern shall be immersed vertically into the flux and shall be moved so that the flux will flow easily through the holes. The dwell time on maximum depth shall be 3 seconds. The test pattern is then pulled out vertically at a rate of about 5 mm/s. Holes that remain filled with flux should be re-opened (for example, by tapping the test pattern). Excess flux shall be drained off by placing the test pattern in a vertical plane for 5 minutes until the flux becomes tacky. The test pattern is fixed to the test apparatus and the soldering cycle is commenced.

7.2 Solderability — Time of Contact with Solder

a) *Wetting Time* — Test patterns shall remain in contact with the molten solder for the appropriate time specified in the relevant specification.

b) *De-wetting Time* — Test patterns shall remain in contact with the molten solder for the appropriate time specified in the relevant specification.

7.3 Evaluation of Solderability and De-wetting

7.3.1 At the completion of the test, flux residues shall be removed with a suitable solvent such as 2-propanol (*iso*propanol) or ethyl alcohol.

7.3.2 Inspection shall be carried out under adequate light with the assistance of a magnifier capable of giving a magnification of between 8 and 12 X.

NOTE — The requirements for solderability and de-wetting shall be specified in the relevant specification.

8. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

8.1 When this test is included in the relevant specification, the following details shall be given, as far as they are applicable:

	Clause Reference
a) Temperature of solder in bath	6·6
b) Type of flux	6·7
c) Method of accelerated ageing, if required	6·8
d) Cleaning procedure for test patterns	7·1
e) Wetting and de-wetting times	7·2

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Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones: 323 0131, 323 3375, 323 9402 Fax :+ 91 011 3234062, 3239399, 3239382
E - mail : bis@vsnl.com. **Internet** : http://wwwdel.vsnl.net.in/bis.org

Central Laboratory:	***Telephone***
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Regional Offices:	
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